DOCUMENT RESUME

ED 184 820 SE 030 365

AUTHOR	Holmes, Barbara J.; Wright, David
TITLE	What Do Young Adults Know About Science? Some Results From Two National Assessments.
INSTITUTION	Education Commission of the States, Denver, Colo. National Assessment of Educational Progress.
SPONS AGENCY	National Center for Education Statistics (DHEW), Washington, D.C.; National Inst. of Education (DHEW), Washington, D.C.
REPORT NO	NAEP-08-S-50
PUB DATE	Feb 80
CONTRACT	OEC-0-74-0506
GRANT	NIE-G-80-0003
NOTE	24p.
AVAILABLE FROM	National Assessment of Educational Progress, Education Commission of the States, Suite 700, 1860 Lincoln St., Denver, CO 80295 ($1.00).
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Educational Assessment; Educational Research; Educational Trends; Elementary Secondary Education; *National Surveys; *Science Education; *Scientific Literacy; *Secondary School Science; *Young Adults

ABSTRACT

Data for this report come from the National Assessment of Educational Progress (NAEP), gathered in three science assessments of 9-, 13-, and 17-year-olds, and young adults. The assessments were conducted in 1969-70, 1972-73, and 1976-77. This paper focuses on changes in science knowledge of young adults from the second assessment to the third assessment and compares performance of young adults with that of 17-year-olds. Results report a uniform decline in scientific literacy among young adults and 17-year-olds, with no difference between the two groups in their performance on science exercises. Observations are also noted regarding patterns of responses as to gender, minority groups, and social factors. (CS)

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WHAT DO YOUNG ADULTS KNOW ABOUT SCIENCE?

SOME RESULTS FROM TWO NATIONAL ASSESSMENTS

No. 08-S-50

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February 1980

National Assessment of Educational Progress
Administered by the
Education Commission of the States
Suite 700, 1860 Lincoln Street
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SE 030 365

The National Assessment of Educational Progress is funded by the National Institute of Education. It is under contract with the Education Commission of the States. It is the policy of the Education Commission of the States to take affirmative action to prevent discrimination in its policies, programs and employment practices.

ISBN 0-89398-301-2

The work upon which this publication is based was performed pursuant to Contract No. OEC-0-74-0506 of the National Center for Education Statistics and Grant No. NIE-G-80-0003 of the National Institute of Education. It does not, however, necessarily reflect the views of those agencies.

WHAT DO YOUNG ADULTS KNOW ABOUT SCIENCE?

Some Results From Two National Assessments

Does American leadership in the sciences reflect a widespread public understanding of science, or is it based upon the activities of only a fraction of our citizens? Is general scientific literacy increasing or decreasing in America? Definitive answers to these questions are difficult to attain without analyzing a variety of social, economic and political factors. However, some context for the question of America's general scientific literacy can be provided by examining survey data gathered by the National Assessment of Educational Progress (NAEP) in three science assessments (Three National Assessments of Science, 1978) of 9-, 13- and 17-year-olds and young adults. The first assessment was conducted in 1969-70, the second in 1972-73 and the third in 1976-77. While each of these assessments included a young adult sample, only the results from the second and third assessments can be used to measure changes in performance.

This paper focuses on changes[1] in science knowledge of young adults from the second assessment to the third assessment and will also compare performance of young adults with that of 17-year-olds in school. Performance in science among the young adult population is of interest because the age range, 26-35, represents for many Americans those years when formal schooling may have ceased and careers are being developed. Moreover, the young adult population is often socially active and concerned about issues of importance to the total society. The results presented in this paper will perhaps provide some clues about how well informed this age group is about some of the scientific facts and principles underlying environmental problems and other areas.

A useful first step toward understanding the adults' results would be to view them in the context of general performance trends among the three student populations. Briefly, these results show that:

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[1]Because National Assessment reports changes in performance over time, some of the exercises administered in the first assessment are not released to the public so that they may be administered in a future assessment. In this way, National Assessment is assured of having a valid base for determining changes in performance over time. In addition, some science exercises were administered to both the 17-year-old and young adult samples so that comparisons between the two age populations can be made.

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- All ages declined in performance from the first to the second assessment. The third assessment found performance levels for 9- and 13-year-olds near that of the second assessment.

- A further decline in performance was noted for 17-year-olds from the second to the third assessment (Three National Assessments of Science, 1978, p. xiii).

The findings indicate that the last decade saw declines in performance in science among the three student populations. Although the rate of decline among 9-year-olds and 13-year-olds appears to have abated, the decline among 17-year-olds continues. The findings for the 17-year-olds are of particular interest here because this age population will become the new young adult population.

Some Changes in Young Adults' Performance

Approximately 2,000 young adults responded to each science exercise in the 1972-73 assessment, and approximately 1,300 young adults responded to each exercise in 1976-77. Exercises administered in each assessment ranged across a very general level of science knowledge, and 20 exercises from the second assessment were administered again in the third assessment. For complete details about sampling, administration, analyses and related aspects of the adult science assessments, the reader may consult Three Assessments of Science, 1969-77: Technical Summary (1979).

Exhibit 1 displays the performance levels for two assessments of young adults nationally and in selected groups (see Appendix A for definitions of the groups). The solid black line indicates national average percentages of young adults correctly responding to the 20 change exercises in 1972-73, and the broken black line indicates national average percentages of young adults correctly responding to the same exercises in 1976-77. The bars represent the positions of selected groups of young adults relative to the national average percentages. Exhibit 1, therefore, depicts the changes in national performance between the two assessments and the changes in groups' positions relative to the nation and relative to their past performance. (See Appendix B for tables stating the average percentage correct for the nation and each group.)

Exhibit 1 indicates that more young adults correctly responded to the 20 change exercises in 1972-73 (44.6%) than in 1976-77 (40.7%). In addition, the decline in performance among the selected groups was generally uniform, with a few exceptions. One exception is that declines in the Northeastern and Central regions were not statistically significant.[2] Another exception occurred among

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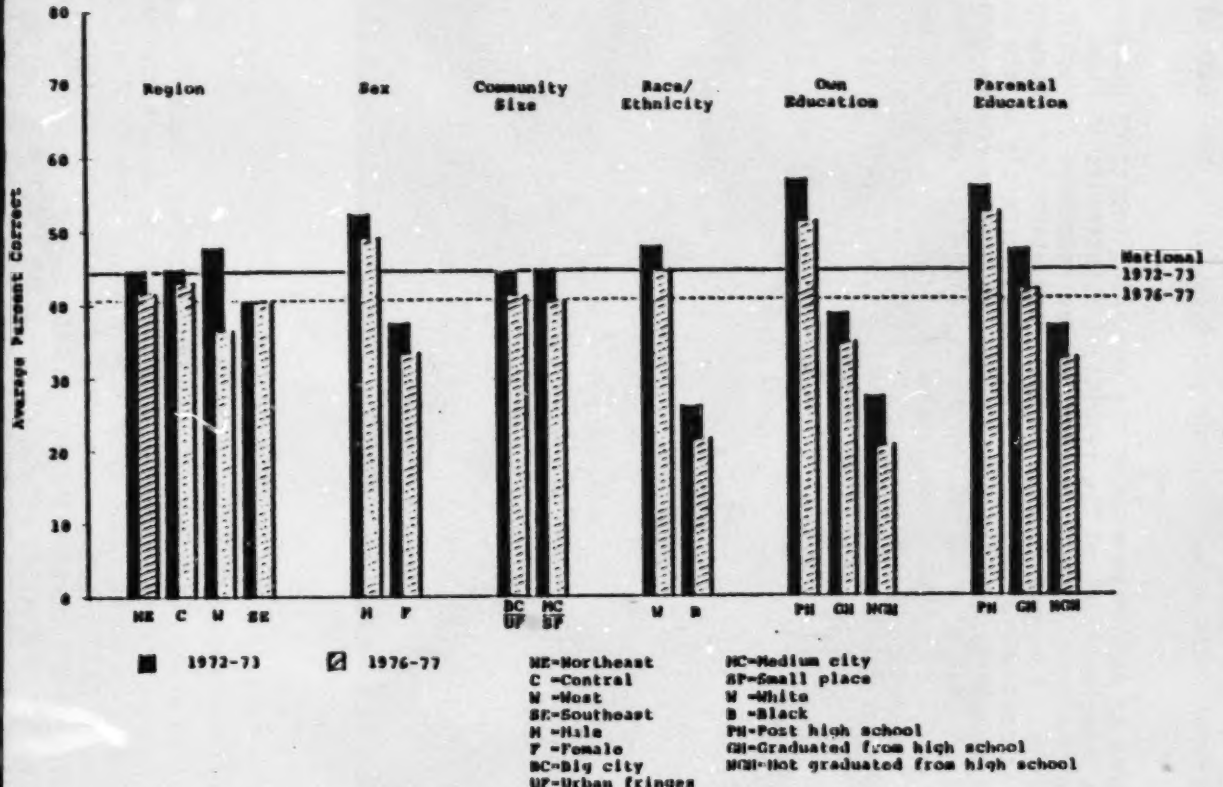
[2]When change statistics are discussed in this paper, only those greater than two standard errors are mentioned. The standard error is a measure of the

EXHIBIT 1. Changes in Performance by Selected Groups of Young Adults on 20 Exercises Administered in 1972-73 and 1976-77 Science Assessments



young adults in the Western region. In the 1976-77 science assessment, significantly fewer young adults in the West correctly responded to exercises than did so in the 1972-73 assessment. Note also that while young adults in the Southeastern region performed below the national average in 1972-73, their performance in 1976-77 was nearly the same as that of the nation. So while the nation experienced a decline, the young adults in the Southeast held their own.

Patterns of performance among the remaining reporting groups are somewhat similar to those observed in the results of assessments in other learning areas. For instance, more males than females responded correctly to the science exercises. The same is true in the "race/ethnicity" category, where we observe that more whites than blacks responded correctly to the science exercises. Young adults residing in big cities or fringes of big cities tended to perform at a somewhat higher level than those who reside in medium cities and smaller places. Of some interest, however, is a comparison between the overall effects of the categories "own education" and "parental education." It appears that "own education" is a more precise indicator of differentials in performance than the "parental-education" category.

Now let's look at some of the exercises used to measure changes in performance. Not only are changes in percentages of correct answers interesting between the two points in time, but the percentages of particular incorrect answers and "I don't know" responses are also of some interest.

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variability of a statistic due to sampling and other random fluctuations. In reporting changes greater than two standard errors, we are confident that changes this large would occur by chance in fewer than 5% of all possible replications of NAEP's sampling and data collection procedures. When summarizing more general trends across age populations, we are less restrictive. For example, most reporting groups in the young adult and 17-year-old populations declined between the two science assessments, but not all declines were statistically significant. However, the consistency of those results seems noteworthy, even if individual changes are not significant.

You are looking to the west and observe a full moon near the horizon. What time is it?

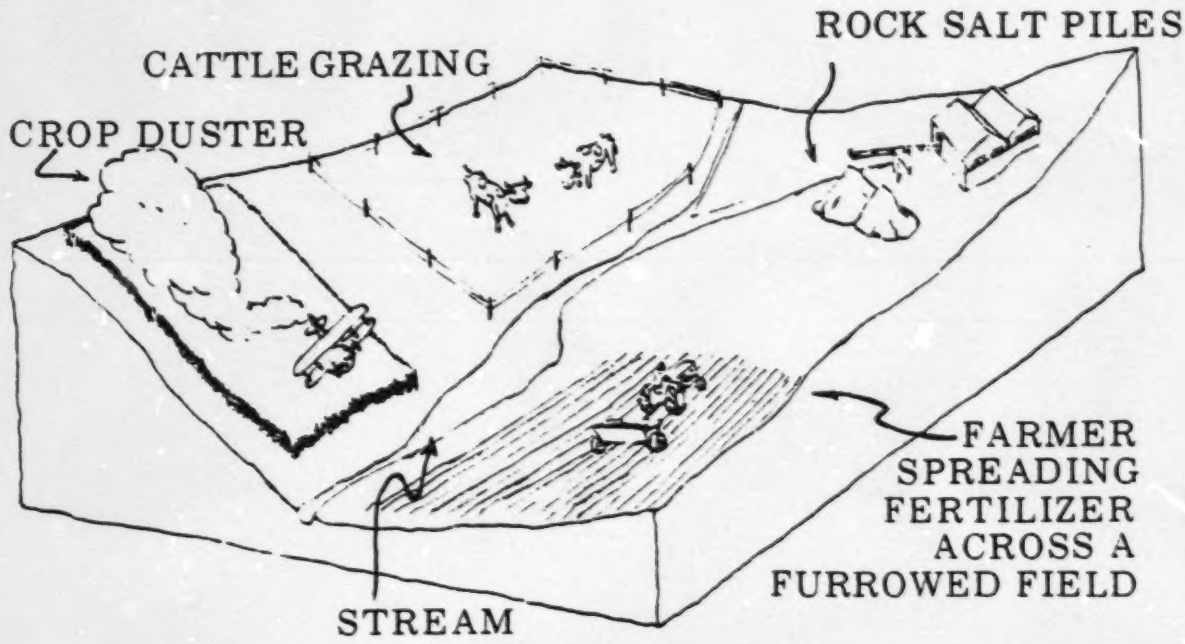
	Percent Responding 1972-73	Percent Responding 1976-77
● It is about sunrise.	37.8	29.5
○ It is about noon.	1.7	2.7
○ It is about sunset.	31.5	37.3
○ It is about midnight.	13.4	14.9
○ I don't know.	15.5†	15.4†

†*Column does not total 100% because of rounding and/or nonresponse.*

Green plants are important to animals because the plants

	Percent Responding 1972-73	Percent Responding 1976-77
○ consume both food and oxygen.	12.8	8.3
○ consume food and give off oxygen.	4.9	8.9
○ consume food and give off carbon dioxide.	2.0	4.0
● produce food and give off oxygen.	63.6	55.8
○ produce food and give off carbon dioxide.	7.7	15.5
○ I don't know.	7.0†	7.2†

†*Column does not total 100% because of rounding and/or nonresponse.*



The crop duster, cattle, salt stored in piles outdoors, and farmer spreading fertilizer CAN ALL

	Percent Responding 1972-73	Percent Responding 1976-77
○ improve the soil.	18.6	20.1
● make the stream water impure.	58.8	44.4
○ kill insects that attack crops.	6.9	8.3
○ make plants grow bigger and faster.	11.3	17.8
○ I don't know.	4.2+	9.0+

+Column does not total 100% because of rounding and/or nonresponse.

Einstein's theory of the basic relationship between matter and energy ($E=mc^2$) was proposed in the early 1900's. Below are some developments that occurred some years later.

Which one was specifically suggested by $E=mc^2$?

	Percent Responding 1972-73	Percent Responding 1976-77
○ Lasers	4.7	4.6
○ Television	4.2	2.6
○ Space travel	6.3	5.9
○ Jet propulsion	8.0	8.6
● The nuclear reactor	39.9	37.8
○ I don't know.	37.0+	40.2+

+Column does not total 100% because of rounding and/or nonresponse.

The blood carries on many functions in the human body. Indicate whether each question describes a function of the blood.

	Percent Responding 1972-73	Percent Responding 1976-77
A. Is it a function of the blood to digest food?		
○ Yes	17.3	22.0
● No	80.3	73.2
○ I don't know.	2.5+	4.5+
B. Is it a function of the blood to protect against disease?		
● Yes	86.6	87.1
○ No	10.7	8.9
○ I don't know.	2.5+	3.6+
C. Is it a function of the blood to carry food to the cells?		
● Yes	87.6	88.0
○ No	9.8	7.3
○ I don't know.	2.5+	4.3+
All 3 parts correct	63.1	57.3

+Column does not total 100% because of rounding and/or nonresponse.

Some Comparisons Between Young Adults and 17-Year-Olds

A collection of 15 science exercises was administered to both the 17-year-old and young adult samples in each of the science assessments. Here is a summary of performance by the two age populations:

	Adults National Average Percent Correct		17-Year-Olds National Average Percent Correct
1972-73	41.9	1972-73	40.6
1976-77	36.4	1976-77	36.8

National average percentages varied only slightly between the two age populations in both assessments. Clearly, performance among 17-year-olds and young adults declined between the two assessments. This same pattern of decline persisted across the selected reporting groups with only two notable exceptions, depicted in Exhibit 2.

Exhibit 2 displays the relative position[3] between the two variables that compose the race/ethnicity category (whites and blacks) and the sex category (males and females). This depiction indicates that gaps in performance between males and females are greater in the young adult population than in the in-school 17-year-old population. The same pattern pertains to the relative position of whites and blacks: gaps in performance between whites and blacks are greater in the young adult population than in the in-school 17-year-old population. It should be noted, however, that the lines for blacks at age 17 and for females at age 17 are inclining, while the lines for whites at age 17 and for males at age 17 are declining. This tends to suggest that the gaps in performance are at least being reduced.

Results from two other assessments (health and reading) of the young adult and the 17-year-old populations indicate that, generally, 17-year-olds know more than young adults. The results of the science assessments, however, suggest an exception to this general pattern. In science, adult males appear to know more than 17-year-old males; however, female adults did not perform as well as 17-year-old females. This is possibly a reflection of the fact that males are generally employed more often in positions requiring some degree of scientific competence than are females. Some evidence for this generalization was noted in the 1976-77 assessment, which asked young adults if they were employed in positions related to science. The performance of those who indicated science-related employment was about 10-15% higher than those who did not.

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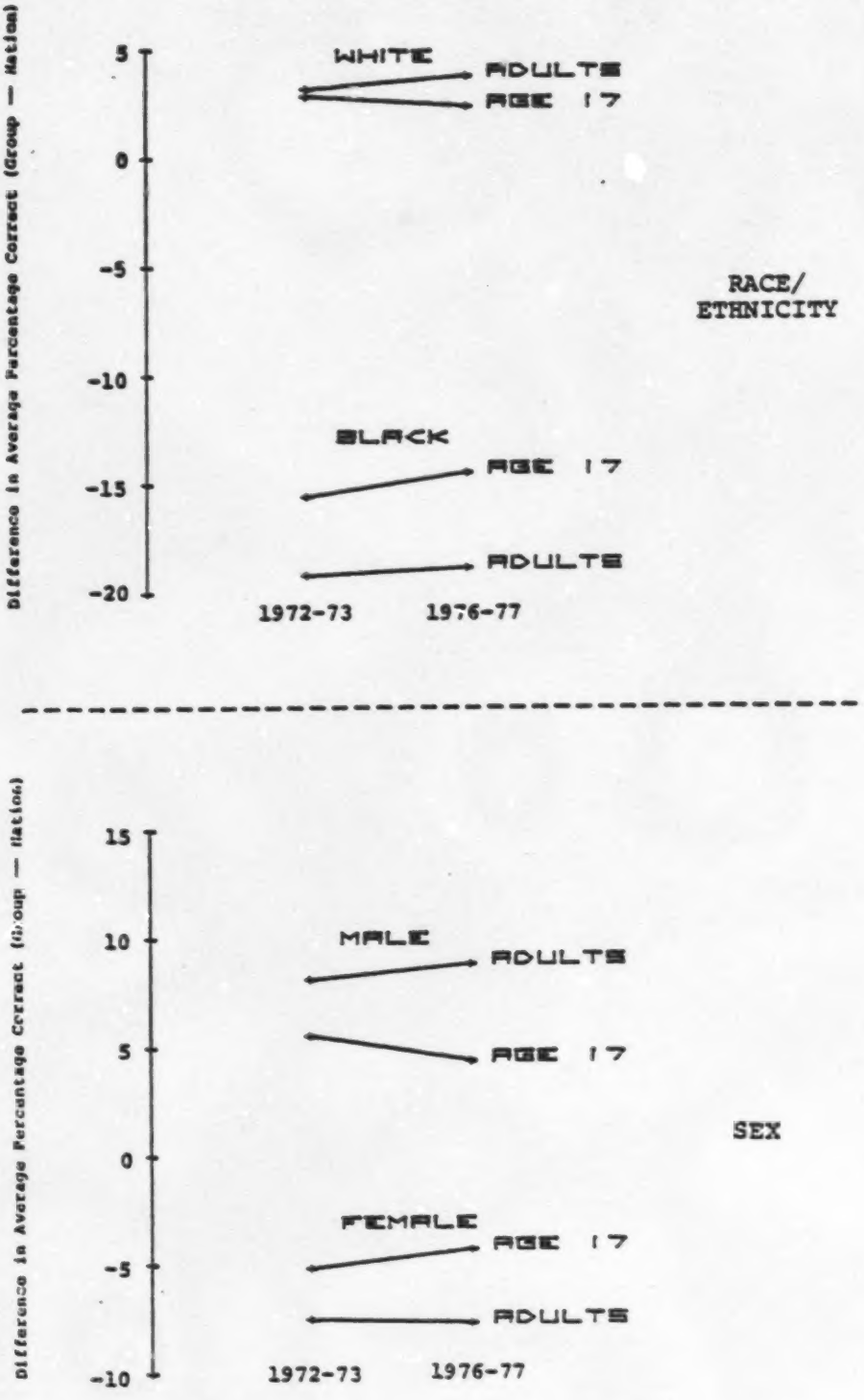
[3]Relative position is the deviation of a reporting group from the nation (group average percent correct minus national average percent correct). This removes the overall time trend and allows us to examine whether groups are becoming more homogeneous over time (e.g., 17-year-old males and females).

EXHIBIT 2. A Comparison Between Young Adults and 17-Year-Olds by Race/Ethnicity and Sex on 15 Overlapping Science Exercises



Following are some of the exercises administered to young adults and 17-year-olds in two science assessments. The declining pattern of performance is evident for both populations, but, more often than not, the declines for 17-year-olds are not as steep as for young adults. Also of interest is the fact that the percentages of "I don't know" responses are somewhat lower among 17-year-olds than among young adults. The slightly higher overall performance by 17-year-olds on these sample exercises can probably be attributed to their more recent exposure to such topics.

A strain of plants has been dwarf for several generations. Seeds from some of these plants were planted. Among the new plants 95 were dwarf and 5 were tall. Which of the following would be the best test of the idea that the 5 tall plants were not mutants but grew tall because of soil conditions?

	Adults		17-Year-Olds	
	Percent Responding 1972-73	Percent Responding 1976-77	Percent Responding 1972-73	Percent Responding 1976-77
○ Cross tall and dwarf plants.	5.9	7.1	8.8	8.6
○ Plant seeds from dwarf plants in poor soil.	2.7	3.7	3.9	3.8
○ Plant seeds from tall plants in the kind of soil the 5 tall plants grew in.	11.3	11.5	7.8	10.7
● Plant seeds from dwarf plants in the kind of soil the 5 tall plants grew in.	53.4	48.9	57.0	52.2
○ Plant seeds from the 5 tall plants in soil to which various vitamins have been added.	14.7	14.0	13.5	16.4
○ I don't know.	11.9+	14.6+	8.8+	7.8+

+*Column does not total 100% because of rounding and/or nonresponse.*

Which of the following is the most important cause of the seasons in the temperate zones of the Earth?

	Adults		17-Year-Olds	
	Percent Responding 1972-73	Percent Responding 1976-77	Percent Responding 1972-73	Percent Responding 1976-77
● The Earth's axis is not at right angles to the plane of its orbit.	25.7	29.9	31.0	27.2
○ The Earth is not always the same distance from the Sun.	49.7	48.8	50.2	51.6
○ The Earth's speed is not constant during the year.	1.6	2.1	2.1	3.5
○ The Earth's surface is mostly covered with water.	3.4	4.3	3.0	4.0
○ The Earth is not a perfect sphere.	2.7	4.4	4.9	4.8
○ I don't know.	16.6†	10.2†	8.4†	8.5†

†*Column does not total 100% because of rounding and/or nonresponse.*

Suppose that a rubber balloon filled with air does not leak and that it is taken from Earth to the Moon. One can be sure that on the Moon, the balloon will have the same

	Adults		17-Year-Olds	
	Percent Responding 1972-73	Percent Responding 1976-77	Percent Responding 1972-73	Percent Responding 1976-77
○ size as on Earth.	40.3	27.5	46.8	38.1
● mass as on Earth.	22.9	26.3	26.8	29.1
○ weight as on Earth.	3.6	4.2	1.8	2.8
○ rate of fall as on Earth.	1.5	1.3	.8	1.0
○ ability to float as on Earth.	19.7	19.4	15.5	15.1
○ I don't know.	11.7†	20.9†	7.4†	10.8†

†*Column does not total 100% because of rounding and/or nonresponse.*

In hot climates, the advantage of buildings with white surfaces is that white surfaces effectively

	Adults		17-Year-Olds	
	Percent Responding 1972-73	Percent Responding 1976-77	Percent Responding 1972-73	Percent Responding 1976-77
○ absorb light.	6.0	6.0	6.5	6.4
○ defract light.	13.1	16.1	13.2	14.9
● reflect light.	64.1	59.8	67.6	62.6
○ refract light.	7.4	7.4	6.9	6.1
○ transmit light.	2.7	6.1	2.0	3.3
○ I don't know.	6.2+	4.2+	3.6+	5.3+

+Column does not total 100% because of rounding and/or nonresponse.

The statement that the relative humidity is 50 percent means that

	Adults		17-Year-Olds	
	Percent Responding 1972-73	Percent Responding 1976-77	Percent Responding 1972-73	Percent Responding 1976-77
○ the chance of rain is 50 percent.	13.6	12.0	15.3	14.3
○ the atmosphere contains 50 pounds of water per cubic mile.	3.8	6.3	5.8	7.1
○ the atmosphere contains 50 grams of water per cubic meter.	12.9	11.5	12.5	12.0
○ the atmosphere would be saturated with water if the air temperature were 50°F.	3.3	3.7	3.9	6.5
● the atmosphere contains half as much water as it could contain at its present temperature.	47.5	42.6	49.0	42.2
○ I don't know.	18.6+	23.7+	13.2+	17.6+

+Column does not total 100% because of rounding and/or nonresponse.

Conclusion

Because of the small number of exercises used to assess the scientific literacy of young adults, results are suggestive rather than conclusive. However, young adults performed less well in 1976-77 than in 1972-73. With the exception of some regional variations, most of the reporting groups reflected the same uniform decline as detected nationally.

Comparison between the young adult and 17-year-old populations suggests that the two age groups are not very different in their performance on science exercises. Moreover, both age populations declined in performance between 1972-73 and 1976-77. Among the reporting groups, however, some interesting patterns are evident. Adult males appear to know more about science than 17-year-old males. The opposite appears to be the case among females. Females at age 17 performed higher on science exercises than female young adults. By the same token, 17-year-old blacks performed higher on science exercises than black young adults. This finding suggests that any differences in performance among school age groups is exacerbated by social mores that often limit the exposure of certain groups to certain opportunities.

Additional assessments of the young adult population would be helpful in establishing clearer trends of this important age group's performance in certain crucial learning areas.

APPENDIX A

DEFINITIONS OF REPORTING GROUPS

National Assessment, unlike most testing programs, does not report scores for individuals. Rather, NAEP reports how defined groups of people respond to certain questions. Definitions of the groups discussed in this report are presented below.

Region

Using the U.S. Office of Business Economics categories, the country has been divided into four regions -- Northeast, Southeast, Central and West. States included in each region are shown on the following map.

Sex

Results are presented for males and females.

Race/Ethnicity

Respondents are classified as white, black or other on the basis of visual observation by the interviewer. Results are given separately for whites and

blacks. The number of respondents classified as "other" was too small to produce reliable results.

Community Size

Size-of-community categories are based upon the populations of the communities in which the respondents being assessed were located.

Big cities and urban fringes: communities with a population greater than 200,000.

Medium cities and smaller places: communities with a population less than 200,000.

Age

The young adults ranged in age between 26 and 35 years.

Own Education

Young adults were asked their highest education levels attained. Respondents are classified into three groups. For purposes of definition, high school refers to grades 9 through 12.

Not graduated high school: young adults who reported they had not graduated from high school.

Graduated high school: young adults who reported they had graduated from high school, but had no formal education beyond high school.

Post high school: young adults who reported they had some formal education beyond high school that may have included business, professional or trade school training as well as college or university training.

Parental Education

Young adults were asked their parents' highest education levels attained. Respondents are classified into three groups. For purposes of definition, high school refers to grades 9 through 12.

Not graduated high school: young adults whose parents did not graduate from high school.

Graduated high school: young adults who have at least one parent who graduated from high school but did not continue beyond high school.

Post high school: young adults who have at least one parent who has had some post high school education.

APPENDIX B

AVERAGE PERCENTAGES CORRECT FOR THE NATION AND SELECTED GROUPS ON 20 EXERCISES

TABLE 1. Performance by Selected Groups of Young Adults on 20 Exercises Administered in 1972-73 and 1976-77 Science Assessments

	1972-73		1976-77	
	Average Percent Correct	Standard Error of Average Percent Correct	Average Percent Correct	Standard Error of Average Percent Correct
Nation	44.6	0.6	40.7	1.0
Region				
Northeast	44.7	1.0	41.7	1.5
Southeast	40.2	1.6	40.5	1.9
Central	44.9	0.9	43.1	1.7
West	47.7	1.4	36.6	2.6
Sex				
Male	52.3	0.9	49.1	1.4
Female	37.4	0.6	33.3	1.0
Collapsed community size				
Big cities/urban fringes	44.4	0.9	41.2	1.5
Medium cities/smaller places	44.7	0.9	40.3	1.5
Race/ethnicity				
White	47.8	0.6	44.6	0.9
Black	25.9	0.9	21.5	1.2
Other	31.9	1.9	28.7	2.5
Own education				
Not graduated high school	27.2	0.7	20.5	1.2
Graduated high school	38.6	0.7	34.7	1.2
Post high school	56.9	0.7	51.3	1.0
Unknown	41.4	3.6	45.0	15.0
Parental education				
Not graduated high school	36.8	0.7	32.5	1.3
Graduated high school	47.3	0.8	41.9	1.1
Post high school	55.9	1.0	52.5	1.7
Unknown	28.3	2.6	23.3	2.2

TABLE 2. National Average Percentages of Correct Responses and Differences in Average Percentage Correct for Sex and Racial Groups of Young Adults and 17-Year-Olds in 1972-73 and 1976-77

	Adults		17-Year-Olds	
	1972-73	1976-77	1972-73	1976-77
National percentage correct	40.6 (.6)[†]	36.8 (1.1)	41.9 (.5)	36.4 (.6)
Difference[††] in average percentage correct (group-nation)				
Male	8.1 (.5)	8.8 (.7)	5.5 (.4)	4.4 (.3)
Female	- 7.5 (.4)	- 7.7 (.7)	- 5.2 (.4)	- 4.3 (.3)
White	3.2 (.3)	3.8 (.8)	2.9 (.3)	2.4 (.2)
Black	-19.2 (.9)	-18.8 (1.4)	-15.5 (.8)	-14.4 (.6)

[†]*Numbers in parentheses are the standard errors of each percentage or difference in percentage.*

[††]*Positive differences indicate performance above the nation, and negative differences indicate performance below the nation.*

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